An Improved Energy Efficient Algorithm For Load Balancing in Cloud Computing

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SYNOPSIS

Title: An Improved Energy Efficient Algorithm for Load Balancing in Cloud Computing

1. Introduction

Cloud Computing is all around us, as it can be defined as in basic terms, the cloud refers to the online storage and access of data and programs, as opposed to storing them on the computer's hard drive. It is a metaphorical representation of this concept. Whenever and every time it is needed, all programs of cloud computing are offered as services. Therefore, the services can be used easily and effectively along with the software storage, network, server, and other services. This leads to huge time and price savings in terms of relevance.

Users not required to installed any software on personal devices as the code can be accessed directly from the cloud. With a vast array of capabilities offered by cloud computing, it has become a crucial aspect of the IT industry. The delivery of cloud services is through the internet, requiring the accessing device to have internet capabilities.

It is necessary for devices to have limited memory capacity, utilize a streamlined software system, and include a web browser.

There are numerous advantages that Cloud Computing offers.:

1. Not requiring the installation of numerous resources results in cost savings for the company,
2. It provides quantifiability and adaptability,
3. The users will increase or decrease the number of services as per requirement,
4. Maintenance value is extremely less as a result of all the resources being managed by the Cloud suppliers

The cloud ecosystem consists of a variety of dissimilar tools that are stored in different locations within data centers. These centers contain various physical devices that hold virtual machines (VMs), each of which incorporates specific processing power settings, RAM, communication data size, and storage capacity. So, consumers don't have a lot of hardware & code [1].

Two elements of cloud computing are the customer & provider.

Supplier receives the task(s) for execution from the consumer. The supplier collects the tasks of the customers, conducts them in the selected knowledge centres, and then returns the results to the user.

The concept of "Cloud computing" was developed to describe the transfer of data to a network of remote servers, enabling employees to access information from any location. Cloud service providers allow customers to store and access files and applications on these servers, which raises concerns regarding the security of the data. Providers of cloud storage must prioritize the protection of their customers' information. It is important for them to not only satisfy their customers; they should collectively meet restricted restrictive needs for confidential information such as MasterCard information and health information to be processed. Third-party audits of the protection systems and processes of a cloud provider make it easier to ensure that information is secure for users [1].

Ensuring data privacy within the cloud is of utmost importance. To achieve this, cloud service providers need to safeguard the access to the cloud against any potential security breaches resulting from mobile devices or compromised login credentials. Additionally, it is crucial to acknowledge that the regulations and privacy policies governing cloud data in another country may differ significantly from those in your home nation.

2. Literature Review

Cloud computing refers to a framework that allows for easy and widespread access to a shared pool of customizable computing resources, including servers, networks, storage, applications, and services, that can be quickly allocated and released with minimal involvement from service providers or management efforts.

The three major key points or highlights of cloud computing can be stated as follows:

- Software-as-a-Service.
- Platform-as-a-Service.

- Infrastructure-as-a-Service

Cloud Service Providers (CSPs) use these services to provide cloud services to their customers. Along with these services NIST definition is also used to provide following four models [2]:

- Private Cloud
- Hybrid Cloud
- Community Cloud
- Public Cloud

Apart from these services and models an integrated view of following five essential and unique characteristics that can be found in every cloud service: on-demand self-service, resource pooling, measured services, rapid elasticity, and broad network access.

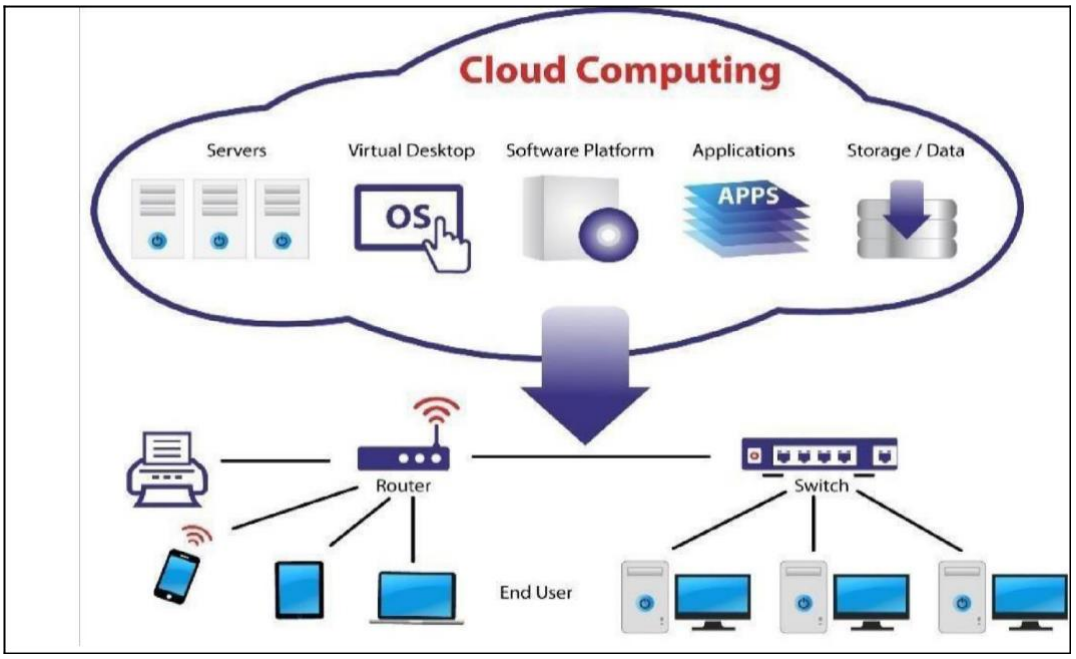

Figure 1.1

Four distinct cloud computing deployment models are:

1. A cloud-based application and processing environment can offer customers the desired cloud computing model for a private cloud [20].
2. The public cloud utilizes third-party resources and application services available on the internet for user computing infrastructure [21].
3. Community clouds are a shared infrastructure among organizations, with applications divided between them within a public cloud coalition [22].
4. A hybrid cloud combines both public and private cloud environments.

The type of cloud service, which provides three models of data modes, is shown in the figure below:

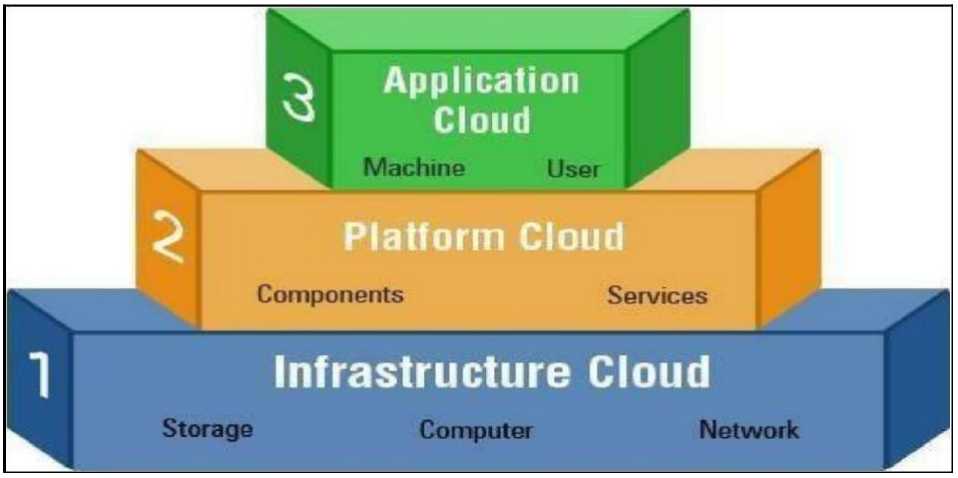

Figure 1.2 Cloud Service Model

The nature of NIST networks, measured on demand for cloud computing services Self-service, resource pooling and rapid elasticity.

The benefits of the cloud computing offerings they are making, some of them are listed below: [23]

- Easy & Aglie Deployment
- Secure Storage Management
- Device & Location Independent
- It provides a flexible and scalable reliable service.
- Reliability,Scalibility & Sustainability

- Pay as you use
- 24/7 availibility

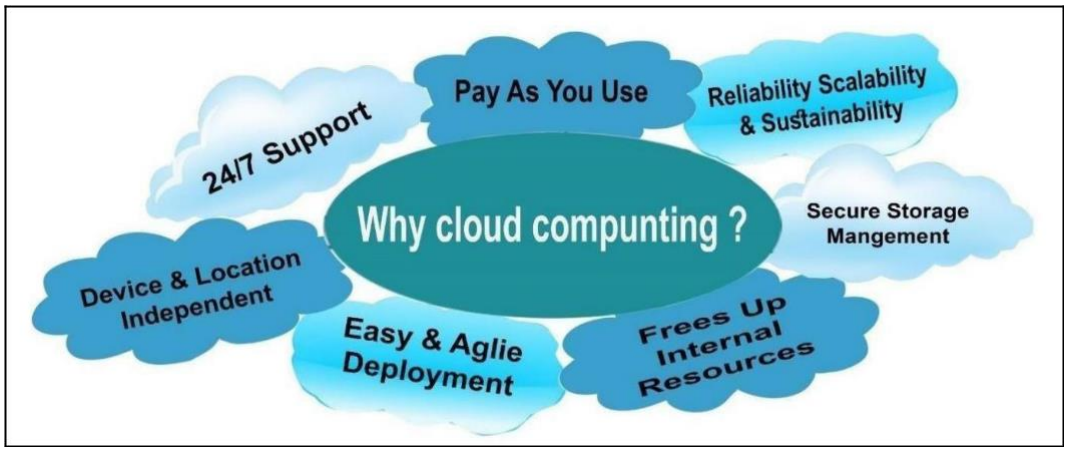

Figure 1.3 Cloud Computing Advantages

2.1 Cloud Components

Three important components of cloud computing are- client systems, data centres and distributed servers.

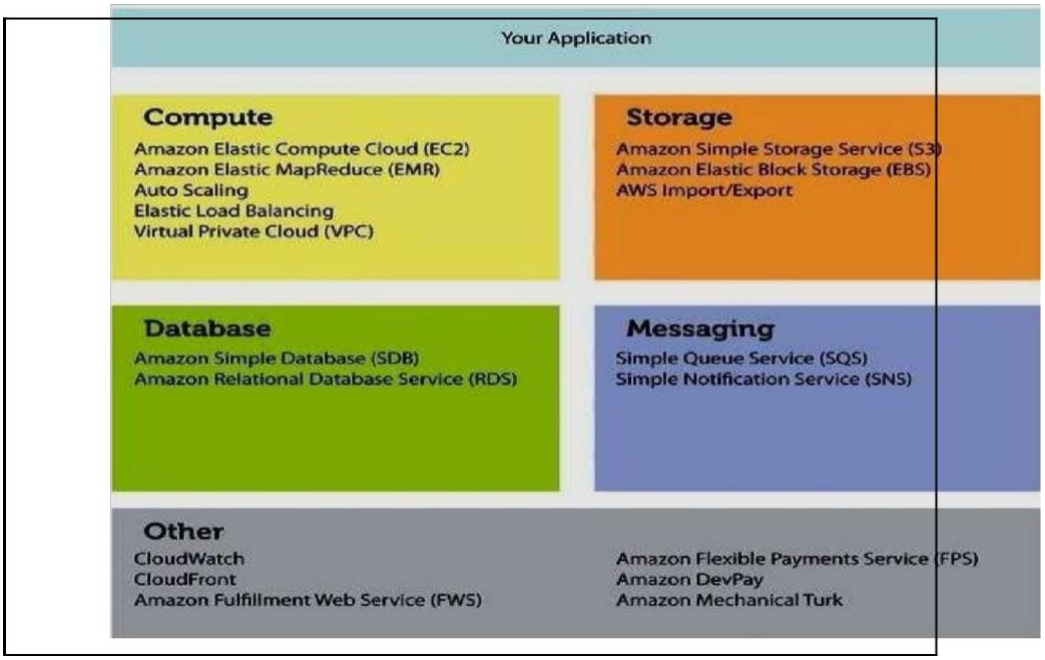

Figure 1.4: Cloud Computing Components

2.2 Clients End

Clients' main role is to interact with cloud servers in order to manage data. Cloud Computing has clients for operating Local Area Network tasks. They are the machines in

form of desktops, laptops, tablets, & smart phones [28]

2.3 Data centre

A collection of various applications of servers build data centre. The dataset end user is connected to subscribe to various applications. Datacentres customers may be present over large distances. Virtualization, a technique utilized in system deployment programs, enables the use of multiple instances of virtual server applications. [29]

2.4 Servers that are distributed

The host is a component of a dispersed server in the online cloud, catering to diverse applications. However, upon utilizing the cloud application, you will observe that your device obtains admission to this function. [10]

2.5 Type of Clouds

They are categorized as: Public, Private & Hybrid clouds.

2.6 Resource Allocation

The concept of cloud computing is gaining traction in the computer industry as a novel computing model. It involves offering dynamically scalable and virtualized resources as a service over the internet. This approach incorporates a variety of established computer and network technologies, such as distributed computing, parallel computing, utility computing, network storage, virtualization, and load balancing, along with other tools. [12].

The concept of cloud computing involves the provision of convenient and immediate network access to a shared collection of adaptable computing resources by creating fundamental hardware and software setups in a data center. The objective of green cloud computing is to develop a low-energy, high-functioning computing infrastructure that operates in a secure and energy-efficient manner.

The primary technology of cloud computing is resource allocation, where computing resources on the network are utilized to simplify the execution of complex tasks that demand extensive computation. [13].

When allocating resources for cloud computing, it is important to take into account various factors including load balancing, makespan, and energy consumption. It is crucial to carefully choose appropriate resource nodes based on the task's specific properties, as stated in reference [15]. Users' service level agreements (SLAs) specify quality of service (QoS) requirements that must be met by assigning cloud resources, as well as minimize energy usage, particularly as highlighted in [14].

Numerous computing service providers such as Google, Microsoft, Yahoo, and IBM are expeditiously establishing data centers across various regions globally to provide cloud computing services, in response to the swift advancements in cloud computing and network communication technology. [20]

Large amounts of electrical energy are consumed by data centers that host cloud applications, resulting in elevated operational costs and environmental harm. Consequently, there is a requirement for environmentally friendly cloud computing solutions that can both decrease operational costs and mitigate the impact on the environment. Governments globally are also exerting greater pressure to reduce carbon footprints, which have a notable influence on climate change [12].

Reducing the energy consumption of data centers presents a difficult and intricate problem due to the rapid expansion of computing applications and data, which necessitate larger servers and disks to process them efficiently within a specified time frame.

When applying green cloud computing to business, it is important to consider the energy consumption and makespan of the allocated resources. As such, optimizing and coordinating resource allocation is necessary to achieve a schedule that is energy-efficient. (Reference: [12])

The primary aim of this project is to create a resource allocation algorithm for virtualized data centers that is energy efficient, with the goal of promoting sustainable practices in green cloud computing. This type of computing emphasizes efficient use of computing resources and reduced energy consumption. The resource allocation algorithm will prioritize energy efficiency in the data center and consider minimizing makespan when assigning resources to tasks. References 13 and 14 support the benefits of green cloud computing.

2.7 Noteworthy Contribution

The author of [3] has described a planning algorithm that is optimized and employs the K-Means clustering rule for task and virtual machine grouping. The suggested system classifies the digital setting by considering the applications accessible on each device virtually.

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The algorithm that incorporates K-means clustering & credits in its planning has been analysed through experimentation has demonstrated superior performance compared to other job planning algorithms.

The presenter of paper [4] discussed the issue of cloud services having a variety of virtual machines (VMs) with different configurations and resource usage, spread across different geographical locations this results in an uneven distribution of resources and tasks These outcomes may arise due to factors such as poor performance, suboptimal energy usage, inability to comply with Service Level Agreement, & system instability. To address these issues, load reconciliation is crucial. The aim of load reconciliation algorithms is to optimize resource utilization, energy efficiency, and reduce carbon emissions. The methods investigated in this paper for load reconciliation include BAT inspired algorithms, Genetic Algorithms (GA), Artificial Bee Colony (ABC), Ant Colony Optimization (ACO), and Particle Swarm Optimization (PSO).

Referring to paper [5], it is unquestionable for the author to correctly use load reconciliation techniques to expand the system's efficiency and minimize price and increase capacity. The multi- objective task planning strategy is mainly based on the Bee Colony rule and its efficiency is checked and tested by the Clouds stimulator. Also, the simplest performance for the predicted work is seen via the experimental study.

The planning algorithms discussed in paper [6] include First Come First Serve, Shortest Job First, Opportunistic Load Balancing, and Generalized Priority Rule. The author tested these algorithms under various conditions and evaluated them based on parameters such as cost and build time. The tests led to the creation of a smart tool that considers user preferences, including job quantity, time, and cost measurements, and recommends the appropriate hardware and planning algorithm to meet their requirements.

Paper [7] presents a credit-based planning rule that utilizes priority, task length, & point in time to improve performance. The experimental results show that the proposed rule outperforms the current rule. Credits are utilized to decrease the task completion time and enable all tasks to be executed in the cloud.

Paper [8] suggests a technique in which priority tasks are allocated to less loaded virtual machines, thereby reducing the minimum completion period, queue waiting time, and improving resource utilization. The study concludes that the proposed method minimizes task completion time and maximizes resource efficiency.

The approach described in paper [9] involves receiving user requests based on priority, size, and type of resource required, and then applying the Bee Colony rule to allocate resources. Performance is evaluated by comparing the requested load and priority to the served load and priority, with a goal of minimizing execution time. This method effectively addresses the unique requirements of each user, including priority execution and resource allocation.

The authors of reference [10] presented in cloud computing a theoretical analysis of job scheduling algorithms. It is a distributed computing model that offers scalability and dynamic resource allocation, enabling developers to deploy applications with storage distribution and job scheduling capabilities. This technology provides a virtualized pool of computer resources that allows local developers to execute applications and allocate resources effectively."

This paper aims to present an analysis of the performance comparison of various previous algorithms for job planning, considering different parameters. It discusses the concepts of distributed computing and its application in space (i). The job planning in cloud computing is explained in section (ii) & Section (iii) discusses the existing algorithms for job planning, comparing them in a tabular form based on different parameters. Finally, section (iv) concludes the paper by providing a brief summary of the work."

In The focus should be on addressing the potential job security planning problem in the context of cloud storage settings in document [11]. The architecture of the cloud computing platform is composed of four layers, which include 1) SOA design, 2) middleware management, 3) resource virtualization, and 4) physical resources.

To ensure safe job planning, we have defined security requirements and trust levels in our work. Our goal is to formally define the issue of duty security planning under cloud computing and propose a genetic algorithm-based safety preparation. Our proposed algorithm is unique in its approach to representing worker schedules by utilizing multiple computers, with each element being diagrammed to illustrate job-computer

relationships. Our experimental studies demonstrate that our method efficiently schedules employment with higher security levels and lower costs.

3. Problem Statement

Cloud computing is a comprehensive term that encompasses various aspects such as virtualization, cloud storage, networking, online services, and applications. A cloud is a complex system that comprises clients, data centers, and distributed servers. It is important to note that plagiarism is an unethical practice and should be avoided at all costs.

In this context, it is essential to guarantee efficiency,fault tolerance, high availability, scalability, minimal customer overhead, decreased ownership expenses, and readily available services. An essential aspect of addressing these concerns is the development of an effective load balancing algorithm. The algorithm must be able to balance different types of loads such as CPU, memory, delay, or network load, efficiently. It is imperative to ensure that the final product is free from any form of plagiarism.

Our goal is to build an effective load balancing algorithm using **Divisible load scheduling theorem** to optimize or reduce various performance parameters (throughput, latency for example) for clouds of different sizes (virtual topology depending on the application requirement).

In order to enhance the effectiveness of virtual machine applications, it is crucial to distribute the workload across cloud servers while dynamically allocating the appropriate amount of resources based on the current load.

In this study, we introduce a refined priority algorithm that allocates resources dynamically, taking precedence into account, and distributes the workload among servers. Our experiments were conducted on a Cloud Platform, and we measured reaction time as the performance metric. Our experimental findings suggest that the suggested algorithm improves overall performance of virtual machine applications by utilizing function scaling and migration. Additionally, our approach avoids plagiarism by appropriately citing any sources used in our research.

Following is the problem statement of our research:

“Is there any improve energy efficient algorithm for load balancing in cloud

computing"

4. Research Objective

Objective for the research work are as follows:

- Identifying all existing energy efficient algorithms used for load balancing
- Performance analysis of the mostly used energy efficicent algorithms for load balancing
- Developing an improved energy efficient algorithm for load balancing in cloud computing

5. Research Methodology

By adopting the method of grouping through K-means, the suggested scheduling algorithm assigns tasks to virtual machines utilizing the load balancing technique honey bee optimization, leading to a decrease in Makespan duration and a boost in resource utilization.

The tasks were sorted based on their length, and then a more efficient scheduling was suggested through clustering with K-means. The cloudlet end clustering was determined by four distinct parameters: task length, priority, deadline, and cost, while clustering at the virtual machine end was based on bandwidth, RAM, MIPS, and size. Three groups were formed, namely high, medium, and low, based on the clustering of the machines and tasks.

Additionally, the clustered groups are sorted and the load balancing Honey bee algorithm was used to attain an optimized balanced scheduling. This algorithm evaluates Virtual machines load and overloaded or underloaded machines assigned the tasks accordingly. In case of an overloaded machine, it transfers tasks to an underloaded machine, and vice versa.

5.1 Proposed System Architecture

In this work, the simulation tool CloudSim was utilized to compare the performance of the proposed algorithm, the current DSJF algorithm is enhanced with K-means clustering and Honey Bee as a load balancing algorithm

The analysis will evaluate the following performance parameters:

a) Time required for completion (Makespan time)

b) Time required for processing

c) Cost incurred during processing

d) Time required for execution

This research study will discuss various algorithms for the resource allocation. The algorithms that already exist are static, dynamic, composite, and prioritized. The ultimate goal of these algorithms is to reduce response time and optimize the usage of the resource. The previous algorithm results are restricted to offer better performance.

Cloud computing is a significant tool in today's technological world, where multiple users utilize available resources in the cloud through services like Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). It is crucial to efficiently allocate resources to end-users while minimizing management and avoiding over or under-provisioning. Elasticity is a key aspect of the cloud, and static scheduling algorithms are not suitable for workload scheduling. Dynamic scheduling is necessary for resource utilization, which can be optimized using various Particle Swarm Optimization (PSO) algorithms. The resources must be available according to the Service Level Agreement (SLA) established between the end-users and Cloud Service Providers (CSP) during the service request. SLA policies and metrics will determine how resources are offered to the end-users. Efficient resource utilization can significantly increase CSP revenue.

Additional research areas to consider are:

• Examining the significance and necessity of allocating resources in cloud computing.

• Analyzing the different policies implemented for resource allocation.

• Investigating the various scheduling algorithms created for resource allocation.

• Assessing the performance criteria of the scheduling algorithms used for resource allocation.

This study will make use of secondary data. Second-hand information gathering is a method of collecting data in which the researcher is not required to be actively or physically involved in the lived events being investigated. This research takes use of data that is available in a variety of media, including printed and electronic versions, and that contains all of an individual's or organizations historical experiences. Secondary data collection is substantially easier and less time consuming than primary data collection for researchers who wish to base their research on prior experiences.

There are an infinite number of resources available for secondary data research that can be used to obtain information. The researcher must make use of data that was collected before to doing the research, which may have been used for other purposes. Newspapers, periodicals, articles, journals (both manual and electronic), financial reports, and internal organisational documents are all common sources of secondary data.

6. Scope of the Study

The scope is to reduce the utilization of physical machines in an enterprise. This strategy is critical as it prevents the occurrence of idle servers which can result in the unnecessary consumption of resources & space.

Implementing effective virtual machine placement is among the techniques used for server consolidation. This approach considers energy efficiency as well.

Different methods have been explored in the past to address the virtual machine placement task. Nevertheless, these researches failed to consider the energy usage of the communication network in data centres. Given that the energy consumption of both physical machines and communication networks carries the same weight, it is crucial to factor in both aspects when striving to achieve energy-efficient virtual machine placement. A physical server refers to a hardware system that executes requests and disseminates data over a network to other computers.

The elements that make up a physical server, including storage, processor, capacity, network connection, and operating system [18], are not distributed throughout the network.

In contrast, a virtual machine is a type of software computer that replicates the functions of a physical computer[19]

Resource scheduling techniques are essential in cloud computing to manage resources effectively while prioritizing the profit of the cloud service provider. These techniques are categorized into three groups:

1. Application layer scheduling,
2. Virtualization scheduling, and
3. Deployment layer scheduling, with each group corresponding to one of the three cloud services (SaaS, PaaS, and IaaS).

To ensure each layer of scheduling criteria is adequately addressed, it is necessary to take into account specific factors including the present workload, various scheduling objectives, and viewpoints from the cloud user, system, and provider. Additionally, the discussion focuses on evolutionary computing algorithms like Genetic algorithms, Ant colony optimization, and particle swarm optimization.

This chapter has explored the different obstacles and research avenues related to real-time scheduling, large-scale scheduling, and dynamic adaptive scheduling for the future. While research in this field is still in its early stages, the increasing prevalence of Big data and the internet of things in cloud computing is expected to bring about new challenges."

The novel idea of cloud computing involves a collection of computer resources in a virtualized pool. The primary area of focus in research and future development is the emergence of green cloud computing. With the scale of cloud computing, energy conservation is becoming an increasingly critical concern.

7. Research Schedule

The following table shows the methodology schedule to achieve research objectives

SN	Activity	Year-1		Year-2		Year-3	
		1	2	3	4	5	6
1	Primary research assessment and formulation of the research problem and research objectives	⟷					
2	Deep literature review		⟷				
3	Research Design & Methodology			⟷			
4	Implement the proposed system				⟷		
						⟷	

5 Testing the result and Performance Analysis

Conclusion

Cloud computing is one of a kind of user oriented technology in which user access a pool of virtualized computer resources. Effective scheduling algorithms can provide customers with more suitable services and improve the efficiency of the cloud environment.

The key goal of task scheduling in the cloud environment is to reduce task execution time and optimize resource usage.This paper compares the proposed algorithm, the technique used involves the application of k-means clustering scheduling with Honey Bee as a load balancing mechanism , to existing DSJF algorithm. Reducing cost is the main goal of scheduling, cover the system, and delegate users' activities. Unlike single functions, the research utilizes a multi-target optimization approach to improve planning performance. The research was able to attain a remarkably effective solution by utilizing the recommended task scheduling algorithm. The study also suggests a more efficient scheduling method utilizing clustering of sorted tasks and machines using k-means, which involves sorting tasks based on length.

The cloudlet performs clustering based on four parameters: task length, priority, deadline, and cost. Virtual machine clustering, on the other hand uses network capacity, memory, computing power, and physical dimensions.This study results demonstrate that the k-means clustering approach using LB_HBA is more effective and cost-efficient than the existing DSJF Algorithm.

Here some study part is also carried out by reading articles of various researchers about various algorithms for the load balancing. The algorithms that already exist are static, dynamic, composite, and prioritized. The ultimate goal of these algorithms is to reduce response time and optimize the usage of the resource. The previous algorithm results are restricted to offer better performance.

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